# DEVELOPING U.S. EPA'S ENVIRONMENTAL TECHNOLOGY COOPERATION CENTER: A NEW APPROACH TO FOSTER TECHNOLOGY TRANSFER PARTNERSHIPS[1]

Christopher James Burke
Argonne National Laboratory
955 L'Enfant Plaza, S.W.
Washington, D.C. 20024-2168
USA



## ABSTRACT

This paper presents a conceptual framework and approach for establishing the U.S. Environmental Protections Agency's (EPA) environmental technology cooperation center. The topic is introduced with background information on events leading to the development and implementation of the center and brief overviews of the domestic and global environmental industries. The paper assesses several U.S. environmental technology transfer programs and identifies significant, innovative, and instructive technology transfer methods which offer constructive models for the center. This examination focuses on several modes of public-private interaction required to facilitate the transfer of U.S. environmental technologies into the international marketplace. Specific case studies of environmental technology cooperation initiatives include: the U.S.-Asian Environmental Partnership (AEP), the U.S. Environmental Training Institute (U.S. ETI) and the recent International Environmental Technology Business Action Conference, which took place in Moscow last month. This information forms a basis for defining the needs, gaps and opportunities for the technology cooperation center.

Technology transfer and cooperation programs must respond to a range of changing needs and requirements in the increasingly competitive and sophisticated global economy of the 1990's. The environmental technology cooperation center concept developed by the U.S. EPA offers an approach for enhancing public-private sector partnerships to improve domestic industry collaborations and enhance trans-national team-building. An innovative approach by EPA, in collaboration with other agencies and the private sector, can lead to the rapid introduction of a global network of national and regional centers to foster international environmental cooperation and team-building in the years ahead.

---

[1] Work supported by U.S. Environmental Protection Agency, Office of International Activities. The author wishes to acknowledge the contributions of Robert Colangelo, Environmental Planning Group, Suzannah Kelly, Argonne National Laboratory, and Ann Brower, Environmental Business Council-U.S.

## INTRODUCTION

In his State of the Union Address of February 17, 1993, President Clinton announced an Environmental Technology Initiative (ETI) to accelerate development and diffusion of environmental technology while strengthening America's industrial base. As the international component of ETI, U.S. Technology for International Environmental Solutions, (U.S. TIES) is an inter-agency technology diffusion program designed to resolve international environmental problems through the application of U.S. technologies, practices, and expertise. Specific activities under U.S. TIES include international technical assistance and training, in-country demonstrations, the generation and dissemination of technology information, and international environmental market and needs assessments.

EPA has proposed the establishment of an international environmental technology cooperation center to serve a central role in fostering environmental international technology partnerships and cooperation. The mission of the center is to serve as:

- a catalyst between the public and private sectors in implementing the diverse range of activities under U.S. TIES;
- an information network for environmental businesses and projects
- a resource for international technology developers and entrepreneurs;
- a financial advisor and facilitator;
- a partner and match-maker in strategic alliances; and
- a team-builder of private sector firms, trade associations, academia, government agencies and other international organizations to resolve environmental problems.

Development of U.S. TIES is consistent with "Agenda 21, The Programme for Action for Sustainable Development" which offers a comprehensive list of recommended actions from the Rio "Earth Summit" . The United Nations Conference on Environment and Development recognized that Agenda 21 could not be implemented through official assistance alone, but would require significant engagement of the marketplace and the private sector, (National Science and Technology Council, 1994). Fundamental to the center's long term role is the recognition that building business-based technology cooperation efforts and partnerships with other institutions and international partners is essential to achieve sustainable development and the goals of Agenda 21.

The challenge facing the EPA center is to: 1) create a sustainable public/private sector initiative with the team-building capacity to address the diverse needs and opportunities posed by global environmental problems; 2) to stimulate and energize the U.S. private sector to resolve international environmental problems; and 3) to harness the diverse capabilities and resources of the U.S. EPA in collaboration with other agencies to effectively achieve limited objectives.

## OVERVIEW OF U.S. INDUSTRY

Environmental technologies are defined as environmental services, technology, energy resources, and related technologies and services contributing to a cleaner environment. Environmental technologies, per se, fall into four broad groups: monitoring and assessment; control; remediation and restoration; and avoidance (National Science and Technology Council, 1994). Each of these groups consists of diverse segments which comprise the environmental industry. The industry is extremely diverse and cuts across a wide cross-section of American business, which is illustrated by the following information summarizing revenue and annual growth for the seven leading industrial segments comprising 90% of the U.S. environmental industry [Environmental Business Journal, 1994 (EBJ)]:

| | '92 Rev in bil.$ | Annual Growth '92 |
|---|---|---|
| • Solid Waste Management | 28.2 | 3% |
| • Water Utilities | 21.2 | 5% |
| • Resource Recovery | 16.1 | 2% |
| • Haz Waste Management | 14.6 | 7% |
| • Environmental Consulting | 14.2 | 6% |
| • Water Infrastructure | 13.0 | 4% |
| • Waste Management Equipment | 11.5 | 5% |

Total annual revenues for the U.S industry have grown from under $40 billion in 1980 to $134 billion in 1992, and with a projected aggregate growth rate of 6%, they are projected to grow to $180 billion in 1997. Shortly after that time the industry is projected to reach its domestic peak, and the viability of many U.S. environmental technology segments will largely depend upon their international market share.

The U.S. environmental industry has grown and diversified widely in recent years, yet has failed in general to successfully commercialize major technology breakthroughs. Through the 1980's venture capitalists frequently spoke optimistically about the future emerging environmental technology market, but their predictions of growth did not materialize into commercial technology successes. As measured by at least one indicator, level of entrepreneurial investment, environmental technology has not generated the level of private equity financing by venture backed companies characteristic of other high growth industrial sectors. For example, from 1991-93 the envirotech industry generated less than 2% of both deals completed and dollars raised in the venture capital industry, compared to communications (17%), electronics and computer hardware (14%), and biotech and pharmaceuticals (19%) (Schofield, J.T., 1994).

The U.S. industry also has not developed an environmental export strategy that has generated results comparable to leading U.S. competitors (EBJ, 1994):

| | Env. domestic market | Env. prod. exported /(%) |
|---|---|---|
| Germany | $36 bil | $11 bil/ 31% |
| United States | $134 bil | $7 bil/ 5% |
| Japan | $ 21 bil | $5 bil/ 24% |

With a large domestic environmental business infrastructure and an aggressive strategic approach to international environmental markets, the U.S. can improve upon its past performance in world markets.

## OVERVIEW OF INTERNATIONAL MARKET

The international environmental market is driven by government policies resulting in legislation and regulations which address specific environmental media. In general international environmental treaties have not been found to be major factors in shaping national environmental programs. Environmental regulatory programs, mainly focused on air and water emissions, have been enacted in nearly all industrialized countries, and to varying degrees, are being developed in newly-industrialized Asian-Pacific economies as well (Burke et al., 1993).

Most of these countries have followed the U.S. model by establishing a central agency to develop and implement programs on a national basis. A notable exception to this policy is the regulation of solid waste, which in most countries is handled at the local, state, or provincial level. In particular, the U.S. approach to hazardous waste embodied by two federal statutes strictly regulating hazardous waste management and liability has not been followed. Several European Community nations have introduced increasingly active and diverse policies in waste minimization and recycling. Many national governments, following the U.S. lead evident in the Clean Air Act Amendments of 1990, are showing growing interest in reducing direct government intervention through use of market-oriented mechanisms.

Though passage of legislation and regulatory development are necessary first steps, enforcement and implementation of environmental standards are necessary to establish markets. Widely divergent approaches to government authority, cultural distinctions, severity of pollution problems and other factors are reflected in the world community's response to ensuring compliance with environmental goals. Each region and nation has managed enforcement and implementation of environmental statutes with different approaches characteristic of its culture, society and/or social system. All national governments, including the U.S. and the rest of the industrialized world, have encountered serious problems with enforcement and implementation of environmental statutes. Thus, the global market is highly fragmented and varies from country to country and region to region (Burke et. al, 1993).

The international environmental market is far less mature than the U.S. market and is expected to grow over 8% annually from $295 billion in 1992 to over $426 billion in 1997. Nations and regions with annual growth rates over 10% include: Canada (11%), Mexico (15%), Latin America (12%), Eastern Europe (14%), and Southeast Asia (16%). The global environmental market is projected to exceed $500 billion around the turn of the century and beyond the year 2000 it will continue to grow, though at slower rates (EBJ, 1994).

## U.S. ENVIRONMENTAL TECHNOLOGY INITIATIVES: THREE CASE STUDIES

This preliminary investigation identified several noteworthy technology cooperation initiatives which provide useful information for formulating an approach for the EPA center. The initiatives presented below are funded with federal support but also draw heavily on private

sector participation. Without such private sector involvement they would not have been successful in responding to domestic market needs and demands. Each program offers valuable and pertinent insight and background information for the development of EPA's center.

In selecting the initiatives below technology transfer/cooperation programs were systematically assessed as to the types of services provided. So-called "soft" or indirect technology transfer programs are programs that generally have indirect and intangible effects on the technology transfer and cooperation process, such as providing technical information and training, access to data bases, and policy, regulatory and legal assistance. On the other end of the spectrum, "hard" or direct technology cooperation efforts include those activities that are directly involved in the transfer process, which may include joint venturing, financial assistance, technology training, technology demonstrations, and transfer of know-how and intellectual property. The case studies below were selected to present a balance of these activities and thus provide a general assessment of their relative impact and importance in relation to the technology cooperation process (see Figure 1). Several general criteria also applied to selection of case studies, including whether and to the degree each program was significant, instructive, and/or innovative in relation to the goals and mission of the center.

## The U.S.-Asia Environmental Partnership

### Mission

The goal of the U.S. AEP is to support sustainable development by enhancing US environmental technology exports to 34 countries in Southeast Asia and the Pacific Islands. US-AEP was conceived in 1991 by the Trade Promotion Coordinating Committee working group chaired by the Department of Commerce (DOC) and the Agency for International Development (AID). Originally conceived as an independent partnership made up of 19 US government agencies, as well as public, private, and non-governmental organizations from both the US and Asia, AEP receives most of its funding from AID. AEP's Secretariat is housed at AID's Washington D.C. offices. Its activities fall into four categories: fellowships and training; technology cooperation; environment and energy infrastructure; and regional biodiversity conservation network.

### Organization

As a government funded program, AEP works with existing programs and organizations; rather than creating its own initiatives, it coordinates the export promotion activities of the 19 member agencies. American members of the partnership include: AID; DOC; Department of Defense (DOD); Department of Energy (DOE); EPA; Export Import Bank; Office of Management and Budget; Overseas Private Investment Corporation; National Aeronautics and Space Administration (NASA); Small Business Administration; Trade and Development Agency; and the Office of U.S. Trade Representative. International participants include the World Bank; the Asian Development Bank; Multilateral Investment Guarantee Agency; and Japan's Ministry of International Trade and Industry.

### Current Operations/Programs

AEP conducts a range of activities of which several are characterized as technology cooperation. Attention here is focused on two specific activities pertinent to the center's mission, AEP's technology transfer program and the Energy and Environmental Assistance Fund.

AEP's technology transfer program operates 9 offices in Asian business centers that are staffed by environmental specialists supervised by the DOC's U.S. and Foreign Commercial Service. The Asian staff perform the following tasks to facilitate technology cooperation:

- Gather information on trade leads, and environmental laws, policies or regulations;
- Transmit information on business opportunities, market intelligence, and regulatory policy data via the Environmental Technology Network for Asia (ETNA). ETNA is a database which matches Asian trade leads to qualified American envirotech firms;
- Promote envirotech through exhibition events and seminars;
- Establish business contacts in the host country;
- Identify potential agents, licensees, and joint-venture partners.

AEP provides information on possible projects and financing, however it provides no follow-up facilitation in acquiring the contract; similarly, it offers no guarantee of successful financing. The environmental technology transfer program works closely with the Department of Commerce and the National Association for State Development Agencies (NASDA).

The Environmental and Energy Technology Fund was established in October 1992 as an AEP initiative with the National Association of State Development Agencies (NASDA). The fund provides grants to small and medium sized businesses to encourage the transfer of environmentally responsible and energy efficient technologies from the US to Asia and the Pacific. Projects may include trade missions, technology seminars, professional exchanges, and equipment demonstrations. During the first year of operation the fund awarded small grants worth $700,000 for 33 projects. The program was extended for three additional years in September of 1993, and currently has completed a total of 87 projects (U.S. AEP, 1993).

Elements of Success

Though the AEP technology transfer program is relatively new and not fully developed, several conclusions can be drawn about its impact. The program has lacked an effective link to the U.S. envirotech business community and ready access to U.S. companies capable of competing effectively in the rigorous Asian market. As a result project opportunities have not been communicated as effectively as possible to U.S. firms capable of responding to them. The center's strong orientation towards private sector needs suggests that this particular niche can be well-served through development of a collaborative effort with the center and AEP. AEP recognizes this gap and has already suggested such a collaboration.

Among the elements considered crucial to the success of the Environmental and Energy Fund are the following:

- matching funds to demonstrate commitment to business and contracts;
- extensive market research before travelling (and giving them contacts to meet with before travelling;
- participation of small businesses; and
- NASDA 30 day turnaround on applications, considered crucial since many firms find government programs too slow.

The partnership AEP has developed with NASDA offers another model for the center to follow in organizing trade missions, reaching small businesses, and extending the scope of activities to domestic users.

U.S. Environmental Training Institute

Mission

The U.S. ETI serves as a link between U.S. business and industrializing countries to facilitate training on environmental technologies. The goal of ETI is two-fold: to increase knowledge of environmental technologies, and to connect U.S. environmental businesses with world markets. ETI's primary activity is the coordination of training courses that are in turn administered by private businesses. ETI was initiated in 1991 with funding from U.S. EPA. Currently several other agencies actively support ETI including Department of Commerce, DOE, and AID. By facilitating contacts between in-country decision makers and U.S. businesses, ETI encourages the transfer of U.S. environmental technologies to developing countries.

Organization

Funded at approximately $3.5 million in 1994, ETI is incorporated as a non-profit training institute overseen by a Board of Directors representing private companies and academia. ETI actively engages the participation of NGO's and the private sector in its activities, effectively leveraging the resources of both. ETI organizes and prepares short term training courses sponsored by U.S. environmental businesses for participants from government and industry. The courses are offered by diverse public and private organizations including private companies, educational institutions, and other government agencies. ETI directs the curriculum of the training sessions while sponsors conduct the actual training and provide training facilities. Government and private sector support is available to participants needing scholarship funding.

Current Operations/Programs

ETI short courses address such topics as waste water treatment, pollution prevention, solid waste disposal and demand side management. ETI has expanded rapidly and offered 16 courses attended by 350 private and public sector representatives from 28 countries in 1993. In 1994 ETI will offer 25 courses attended by over 650 participants. Most of the courses are presented in Washington, D.C., but an increasing number of courses are held in Latin America, the Caribbean, Eastern Europe, and Asia and focus on environmental concerns in these areas. Courses are generally 5-10 days in duration and include hands-on training, demonstrations, and

site visits to operating facilities. ETI focuses on results by assisting with appropriate follow-up. Attendants develop an action plan of goals and identify information and support required. Regional follow-up meetings are planned this year with alumni and U.S. technical experts for project planning and on-site consultations, (U.S. ETI, 1994).

Elements of Success

EPA assisted in the design of ETI's training approach, and points to ETI as a good example of an effective public-private partnership. ETI's 1994 funding was derived equally from the several federal agencies noted above and private sector firms which contributed both in-kind services and financial support. Such balanced sustainable funding is, in itself, a significant accomplishment. Among the other factors contributing to ETI's success include the following:

- Needs-based: Each course is developed and designed to address the participants' concerns and U.S. business sponsors;
- Client-focused: ETI is committed to helping sponsors and participants alike achieve their goals, and therefore effective course follow-up is a major element of ETI's effort;
- Results-oriented: ETI maintains contact with course alumnae to ensure project follow-through and provide in-country consulting and planning.

International Environmental Technology Business Action Conference-MOSCOW '94

Mission

This innovative initiative represents an experiment in technology transfer and commercialization and was sponsored by U.S. DOE. The total budget for this project totaled approximately $500,000. Several other agencies including DOD, NASA, and EPA participated in some form in the conferences activities. The mission of this project was to validate an innovative approach to technology transfer that facilitated the commercialization of post-Soviet developed environmental technologies applicable to DOE, DOD, NASA and private sector environmental restoration and management needs. Far more than a single event, this project represents a six-month long technology solicitation, review and selection process, and technology competition to lay the groundwork for creating ventures between post-Soviet technology innovators and U.S. partners.

Organization

DOE's subcontractor for this project, Environmental Planning Group Inc., organized and executed this effort. Six months prior to the action conference, a technology competition was organized to educate post-Soviet scientists on the needs of the U.S. environmental industry and the 15 key sectors that comprise the U.S. environmental market. The scientists were then presented with key environmental technology needs and asked to submit a completed application if they had access to a technology that met the presented needs.

Over 500 applications from 166 research institutions from throughout the former Soviet

Union were submitted and reviewed by a panel of environmental experts drawn from public and private sectors in the U.S. Fifty finalists that were judged to have the highest likelihood of commercialization by a U.S. company were selected to attend the three day action conference in Moscow. U.S. companies with complimentary manufacturing expertise were contacted and attended the event to preview the technologies. Interaction and match-making was actively encouraged at the conference through workshops, poster sessions, receptions, and other activities. Finally, three leading technologies were selected by a blue ribbon panel of experts and each was awarded a $2,000 cash prize.

Current Operations/Programs

As a result of the process presented above over twenty business relationships or joint ventures were generated which fell into several classes as follows:

1) A Russian research and development (R&D) organization has a particular technical expertise which compliments a U.S. firm's marketing manufacturing, or consulting capabilities. The company is in the process of arranging meetings to further evaluate the potential relationship;

2) A U.S. research institute identified a post-Soviet partner to conduct collaborative R&D efforts;

3) A post-Soviet R&D organization developed a specific technology which compliments a U.S. company's capabilities. The technology needs product modification, additional R&D, or validation before it is ready to take to market. The U.S. company currently is evaluating the potential of forming a joint venture, conducting collaborative R&D, or conducting a market assessment;

4) A post-Soviet R&D organization has produced a technology with immediate market potential is in the process of forming a joint venture or creating a separate entity with a U.S. company to provide a product, service, or licensable technology.

Elements of Success

The MOSCOW '94 Conference was considered a success by the sponsors, the organizers, and by nearly all the 300 participants. Over ten joint ventures have already resulted from the project and more are expected. A simple but effective model for technology transfer and commercialization was created which brings customer needs together with technology producers while allowing the providers of business support services the opportunity to support the creation of new ventures.

The development of the technology transfer and commercialization model used to create new trans-national joint ventures can be improved and repeated to increase its effectiveness. As demonstrated at MOSCOW '94, customers benefits because they are able to identify and purchase faster, better, safer, and less expensive technology developed through a competitive

approach. The technology developer gains ready access to major markets at one time and also benefits from interaction with other developers, customers, technology facilitator and others. Plans are now being developed to host a Technology Competition on an annual basis and include technologies from Western European and North American technology developers. Leveraging private sector support for future activities is facilitated by the positive results of the First International Environmental Technology Business Action Conference, MOSCOW '94.

## SUMMARY AND CONCLUSIONS

From this discussion several important opportunities, gaps and market needs associated with the development of the EPA international environmental technology cooperation center emerge as important factors in the planning process, including:

- The need for improved program coordination is a strategic requirement that must be incorporated into the planning process for the center, and must be reflected in ongoing program development. The center must effectively harness existing program resources while generating innovative approaches to unresolved problems. For example, ETI's success must be recognized and enhanced by projects initiated by the center. Emphasis on building partnerships with existing entities can yield faster, better, and cheaper results. Coordination of the center's activities with the EPA's Environmental Technology Initiative must also be recognized as a key objective.

- The identification and resolution of specific niche needs of industry and existing programs is a potential function of the center. In order to improve the performance and effectiveness of existing technology cooperation efforts, the center can use limited resources to identify and address the gaps in existing programs, such as the needed linkage between AEP's technology transfer program and U.S. environmental technology businesses.

- Model relationships between publicly funded programs and private sector participants can serve as building blocks for successful collaborations. The AEP's partnership with NASDA and ETI's joint ventures with various private sector firms stand as examples of the type of relationships the center must pursue in carrying out its mission.

- As in the case of MOSCOW-94 the center must be able to recognize and engage in new (better, faster, more effective) program development where market demands, technology opportunities, or in-country or regional variations demand new approaches. The center must employ new methods and new strategies in a cost-effective and results-driven implementation plan.

From these observations, desirable elements for the center's strategic approach may include the following:

- strategically targeted activities aimed at well defined markets and users to

conserve resources, reduce waste and duplication, and promote short term results.

- high level of interaction with agencies, private sector, target markets, and users to ensure real needs are met;

- maximum adaptability in a business environment characterized by change, diversity, and demand for timeliness, information, and overall quality to establish an enduring, sustainable organization responsive to market requirements;

- widespread access to state of the art information system to provide first-rate market intelligence and other information necessary for planning and program execution;

- balanced revenue support from federal agencies, private sector, NGOs and international participation, in diverse forms including contracts, grants, matching funds, memberships, information sales and service fees;

- Close connections and teamwork with in-country hosts, joint venture partners, and strategic alliances.

## REFERENCES

Burke, C.J. et al., 1993. "Comparison of International Environmental Policies" Argonne National Laboratory, Washington, D.C., March.

Environmental Business Journal, 1994. "Background Information on Domestic and International Environmental Industry", San Diego, California.

National Science and Technology Council, 1994. "Technology for a Sustainable Future: A Framework for Action", Washington, D.C. July.

Schofield, J.T., 1994. "Commercialization and Financing of Environmental Technology", Environmental Industry Summit Meeting, (Washington, D.C. September 12-13) Thermatrix Corporation.

U.S. Environmental Training Institute, 1994. "US ETI Prospectus and 1994 Catalogue of Courses", U.S. ETI, Washington, D.C.

U.S. Asian-Environmental Partnership, 1993. "U.S.-AEP Annual Report" U.S.-AEP, Washington, D.C.

## AUTHOR BIOGRAPHY

Christopher J. Burke [redacted] attended Phillips Academy Andover and Oberlin College where he earned a B.A. in Geology in 1972. His early experience included field engineer on the trans-Alaska pipeline and oil field geologist in Alaska, Texas, and Florida. In 1977, he was recruited to serve as Legislative Assistant for U.S. Senator John A. Durkin, where he assisted in the Senator's work on the National Energy Plan. Later, while serving as Senior Advocate for Energy and Natural Resources at the U.S. Small Business Administration, he was instrumental in the early development of the Small Business Innovation Research program (SBIR) at U.S. DOE.

Mr. Burke later moved to California and was appointed Senior Energy Advisor in the California Governor's Office. In 1984 he became president of Trident Energy Systems, a leading manufacturer and marketer of residential and commercial solar energy appliances in Davis, California. Mr. Burke led several product developments, including an integrated systems development contract for the Solar Energy Research Institute, now the National Renewable Energy Laboratory.

Mr. Burke returned to Washington, D.C. in 1987 to work as a consultant in international energy and environmental technology issues, and has recently earned an M.S. in Technology Management from the University of Maryland. He joined Argonne National Laboratory in 1992, where he specializes in international energy and environmental energy and environmental technology programs. Most recently, Mr. Burke is project manager for the feasibility study and implementation plan for EPA's environmental technology center.

Figure 1: Technology Transfer Mechanisms

Direct (Hard)

Joint Venture

Intellectual Property Transfer

Technology Demonstrations

Technology Training

Project Development

Financial Advice

AEP Environmental & Energy Fund

Reverse Trade Missions

AEP In-Country Commercial Liaison

Moscow '94

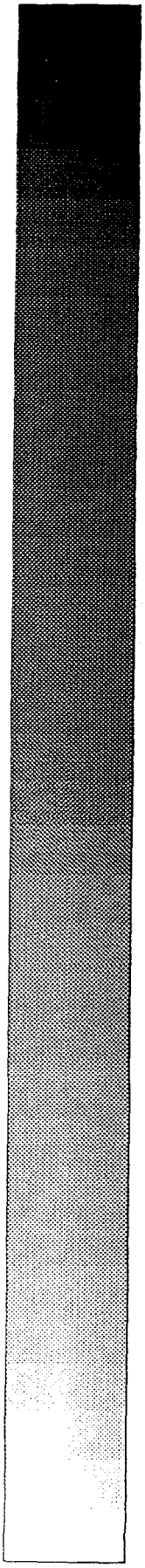
Trade Conferences

USETI

Education/Training

Policy/Regulation/Legal Assistance

Information Access



Technology Transfer Mechanisms

Indirect (Soft)

Source:
Argonne National Laboratory